Revisiting extreme precipitation amounts over southern South America and implications for the Patagonian Icefields

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Contents of this file

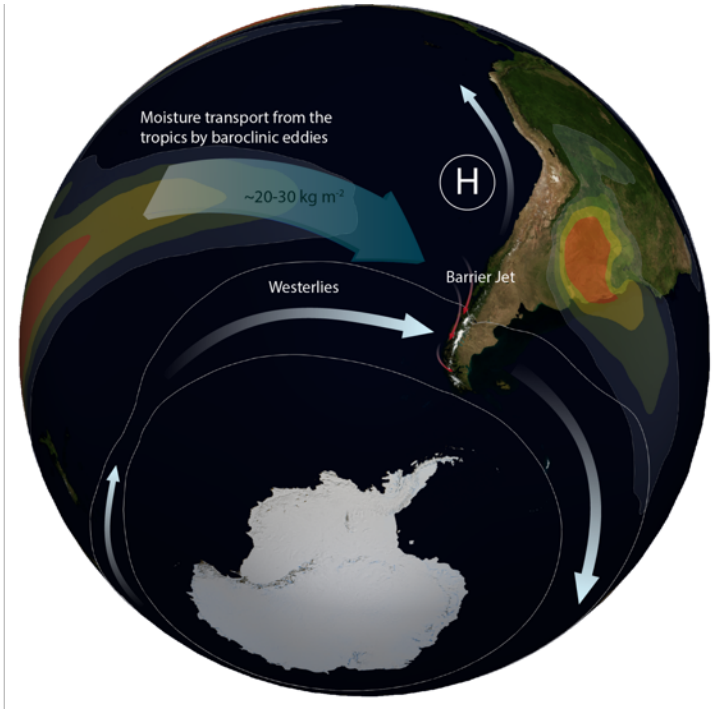

Figure S1: Schematic illustration of the atmospheric large-scale circulation and moisture transport in the South Pacific. Shown are the location of the westerlies for austral summer (December-January-February), the barrier jet along the Andes (red arrows), and the mean moisture transport by baroclinic eddies (blue shaded arrow). The shading indicates regions of high water vapor variability.

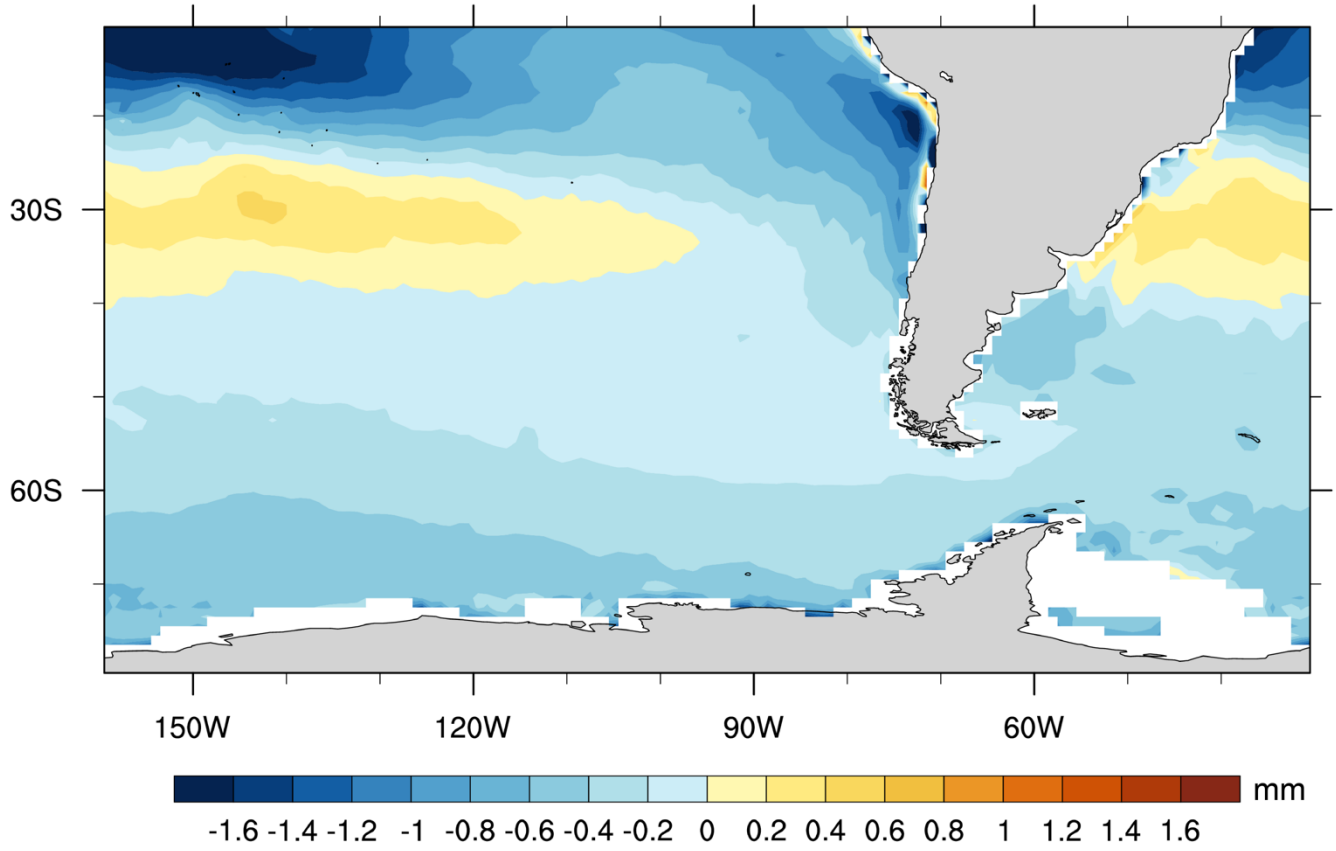

Figure S2: Mean differences in the IWV between ERA Interim and SSMI data for the period 1988-2016. Red shading indicates a positive bias in the ERA Interim data.

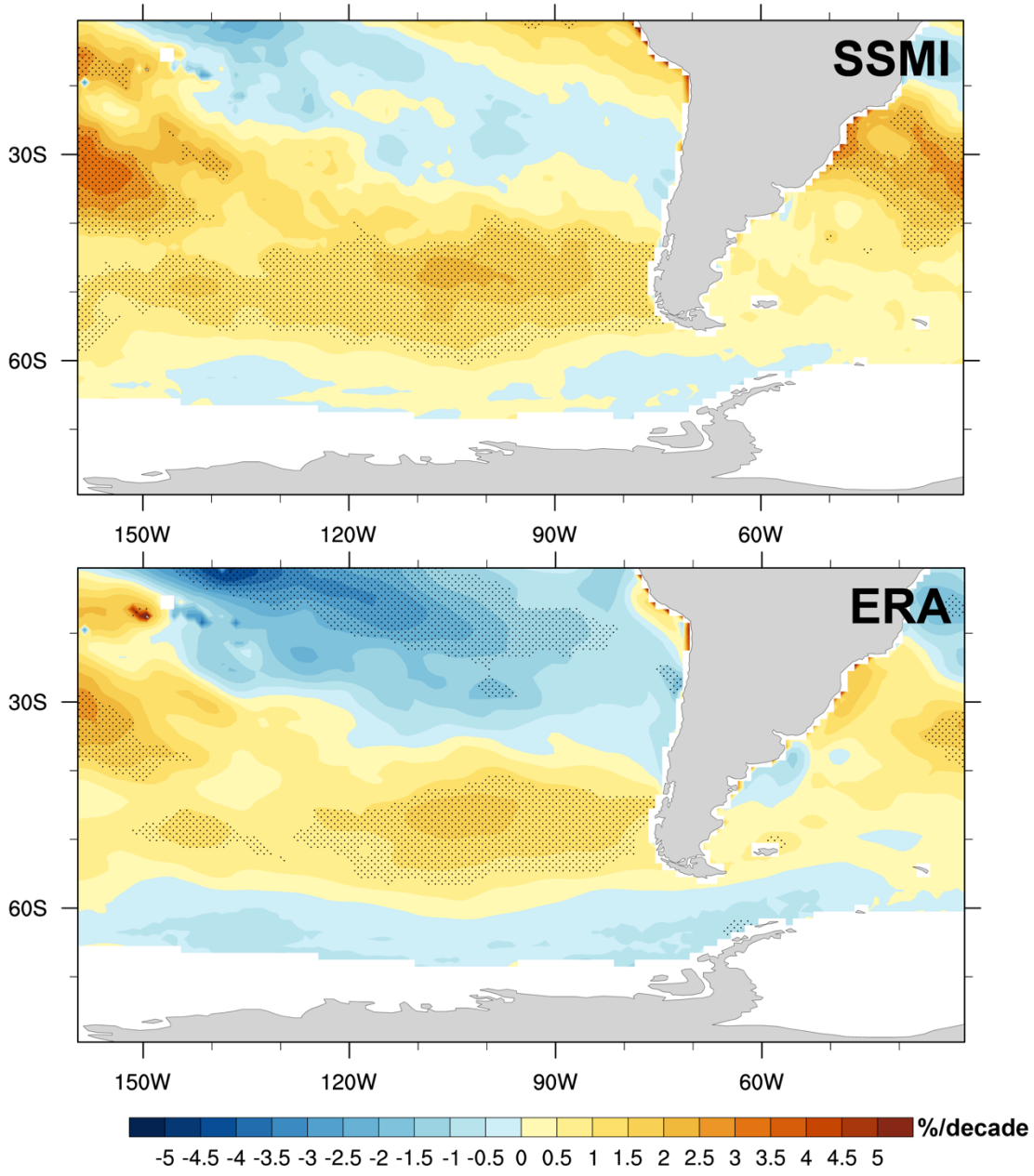

Figure S3: Linear trend of IWV in the SSM/I and ERA-Interim data for the period 1988-2016 (in % per decade). Dotted areas indicate significant long-term trends ($p<0.05$).

Table S1. Comparison of the IWV trends between atmospheric soundings and the nearest ERA-Interim grid point. Numbers are given in mm decade^{-1}. Bold numbers indicate significant trends ($p<0.05$).

	1988-2016	1988-2009	2010-2016
Puerto Montt			
Radiosounding	-0.22 (-1.5%)	-0.42 (-3.0%)	2.87 (19.4%)
ERA-Interim	-0.16 (-1.3%)	-0.25 (-2.0%)	0.65 (5.2%)
Punta Arenas			
Radiosounding	0.23 (2.2%)	0.07 (0.6%)	1.23 (11.3%)
ERA-Interim	0.14 (1.3%)	0.05 (0.4%)	0.80 (7.0%)

Table S2. Comparison of the OPM (DR=0.45) with observations. Given are the latitude (lat), longitude (lon), altitude (alt), the precipitation values from the orographic precipitation model (OPM) and the observations (Obs) at the weather stations The precipitation values are given in mm yr^{-1}.

Location	lat	lon	alt	OPM	Obs
Villa Cerro Castillo	-46.12	-72.15	345	471.30	282.45
Rio Ibaez En Desembocadura	-46.26	-71.99	220	298.12	623.58
Bahia Murta	-46.46	-72.66	240	849.30	1017.93
Lago General Carrera Fachinal	-46.54	-72.22	18	579.54	333.60
Glaciar San Rafael	-46.64	-73.85	8	3829.02	1271.60
Puerto Guadal	-46.84	-72.70	210	745.45	656.28
Estancia Valle Chacabuco	-47.11	-72.48	343	613.92	159.60
Rio Nef Antes Junta Estero El Revalse	-47.13	-73.08	281	895.86	974.88
Rio Baker En Angostura Chacabuco	-47.14	-72.72	160	673.35	856.73
Lago Cachet 2 En Glaciar Colonia	-47.19	-73.25	427	1088.06	243.25
Lord Cochrane Ad.	-47.24	-72.58	204	744.24	652.65
Rio Cochrane En Cochrane	-47.25	-72.56	140	788.03	514.75
Rio Colonia En Nacimiento	-47.33	-73.11	146	986.30	1261.80
Caleta Tortel	-47.79	-73.53	10	2389.95	1870.28
Rio Pascua Ante Junta Rio Quetru	-48.15	-73.08	20	1668.09	2137.12
Lago Ohiggins En Villa Ohiggins	-48.51	-72.59	300	752.40	909.18
Candelario Mancilla	-48.87	-72.73	300	850.18	519.25

Rio Punta Eva En Puerto Eden	-49.11	-74.41	10	3607.47	2840.15
El Calafate Aero	-50.26	-72.05	204	433.19	149.60
Lago Dickson	-50.82	-73.11	200	1301.05	1130.96
Lago Paine	-50.84	-72.90	440	1132.83	500.30
Cerro Guido	-50.89	-72.33	230	820.83	312.50
Amalia	-50.95	-73.69	0	4350.81	2801.60
Rio Paine En Parque Nacional 2	-50.96	-72.79	90	1139.24	724.67
Nunatak Grey	-50.97	-73.22	300	1414.56	589.70
Lago Sarmiento	-51.01	-72.71	110	1111.92	352.85
Lago Pehoe	-51.07	-72.99	40	1347.67	868.18
Lago Grey	-51.11	-73.13	50	1397.74	663.07
Glaciar Tindall	-51.11	-73.28	345	1584.05	1200.28
Torres Del Paine	-51.18	-72.96	25	1431.40	750.34
Rio Rincon En Ruta Y-290	-51.31	-72.82	36	1554.36	769.70
Rio Serrano En Desembocadura	-51.33	-73.10	25	1671.86	1227.01

Table S3. Summary of the WRF configuration.

	Value
Domain configuration	
Horizontal grid spacing	12.5-km, 2.5-km, and 500-m
Vertical levels	55
Model top pressure	100 hPa
Model physics	
Radiation	RRTMG
Microphysics	Morrison
Cumulus	Kain-Fritsch
Planetary boundary layer	MYNN Level 2.5
Atmospheric surface layer	Monin Obukhov
Land surface	Noah-MP
Top boundary condition	Rayleigh damping

Lateral boundaries	
Forcing	ERA-Interim 0.75ºx0.75º, 6-hourly